

## CLAIMS

What is claimed is:

- 1                    1.        A method of treating a surface of a substrate, the method  
2 comprising:  
3                    (a)       forming hydroxyl groups on an oxide surface by exposing the  
4 surface to a plasma;  
5                    (b)       reacting a first gas comprising epoxy-functional molecules with  
6 the surface hydroxyl groups *in situ* in the absence of plasma to provide surface-bound  
7 spacer chains.
- 1                    2.        The method of claim 1, further comprising immobilizing  
2 biomolecules on the surface by reacting the biomolecules with the surface-bound  
3 spacer chains.
- 1                    3.        The method of claim 2, wherein the biomolecules are amine-  
2 functionalized or amine-containing biomolecules.
- 1                    4.        The method of claim 1, wherein the oxide surface comprises a  
2 silicon oxide.
- 1                    5.        The method of claim 4, wherein the oxide surface comprises  
2 silica, glass or quartz.
- 1                    6.        The method of claim 1, wherein the oxide surface comprises a  
2 metal oxide.
- 1                    7.        The method of claim 6, wherein the metal oxide comprises a  
2 native oxide of stainless steel.
- 1                    8.        The method of claim 1, wherein the plasma is formed from a  
2 source gas comprising water, oxygen or a mixture thereof.
- 1                    9.        The method of claim 1, wherein the epoxy-functional  
2 molecules are epihalohydrin molecules.

1                   10.     The method of claim 9, wherein the epihalohydrin molecules  
2 are epichlorohydrin molecules.

1                   11.     The method of claim 1, wherein the epoxy-functional  
2 molecules are diepoxide molecules.

1                   12.     The method of claim 11, wherein the diepoxide molecules are  
2 1,4-butanediol diglycidyl ether molecules.

1                   13.     The method of claim 2, wherein the biomolecule is selected  
2 from the group consisting of oligonucleotides, aptamers, cDNA and RNA.

1                   14.     The method of claim 2, wherein the biomolecule is a protein.

1                   15.     The method of claim 1, further comprising extending the spacer  
2 chains by reacting the spacer chains with spacer molecules *in situ* in the absence of  
3 plasma to provide extended spacer chains.

1                   16.     The method of claim 15, wherein the spacer molecules  
2 comprise an amine group capable of reacting with the epoxy functionality of the  
3 spacer chains.

1                   17.     The method of claim 15, still further comprising immobilizing  
2 biomolecules on the extended spacer chains by reacting the biomolecules with the  
3 extended spacer chains.

1                   18.     An inorganic oxide substrate comprising:  
2                   (a)     an inorganic oxide substrate surface;  
3                   (b)     one or more molecular spacer chains covalently bound to the  
4 surface, the one or more spacer chains having a length of at least 2.5 nm; and  
5                   (c)     one or more biomolecules covalently bound to the one or more  
6 molecular spacer chains.

1                   19.     The substrate of claim 18, wherein the substrate surface  
2 comprises an inorganic oxide selected from the group consisting of glass, silica and  
3 quartz.

1                   20.     The substrate of claim 18, wherein the substrate surface  
2 comprises a metal oxide.

1                   21.     The substrate of claim 20, wherein the metal oxide is a native  
2 oxide of stainless steel.

1                   22.     The substrate of claim 18, wherein the one or more spacer  
2 chains have a length of at least 4 nm.

1                   23.     The substrate of claim 18, wherein the one or more spacer  
2 chains have a length of at least 5 nm.

1                   24.     The substrate of claim 18, wherein the one or more  
2 biomolecules are proteins.

1                   25.     The substrate of claim 18, wherein the one or more  
2 biomolecules are enzymes.

1                   26.     The substrate of claim 18, wherein the one or more  
2 biomolecules are oligonucleotides.

1                   27.     A method of treating a surface of a substrate, the method  
2 comprising:

3                   (a)     implanting silicon-chlorine functionalities into the substrate  
4 surface by exposing the surface to a chlorine-containing plasma;

5                   (b)     forming hydroxyl groups on the surface by exposing the  
6 silicon-chlorine functionalities to a gas comprising water, oxygen or a mixture  
7 thereof; and

8                   (c)     reacting a gas comprising epoxy-functional molecules with the  
9 surface hydroxyl groups *in situ* in the absence of plasma to provide surface-bound  
10 spacer chains.

1                   28.     The method of claim 27, wherein the chlorine-containing  
2 plasma is ignited from a gas selected from the group consisting of dichlorosilane,  
3 silicon tetrachloride, hexachlorodisilane and mixtures thereof.

1                    29.     The method of claim 27, wherein the epoxy-functional  
2 molecules are epihalohydrin molecules.

1                    30.     The method of claim 27, wherein the epoxy-functional  
2 molecules are diepoxide molecules.

1                    31.     The method of claim 27, further comprising immobilizing  
2 biomolecules on the surface by reacting the biomolecules with the surface-bound  
3 spacer chains.

1                    32.     The method of claim 27, further comprising extending the  
2 spacer chains by reacting the spacer chains with spacer molecules in situ in the  
3 absence of plasma to provide extended spacer chains.

1                    33.     The method of claim 32, further comprising immobilizing  
2 biomolecules on the extended spacer chains by reacting the biomolecules with the  
3 extended spacer chains.